Unit 1

• Introduction to Biology and the Scientific Method (Chapter 1)
• Read over the following summary of Unit 1.
• Answer the questions that follow (Questions 1 – 4).
• **8 Characteristics of Life:**

1. **All living organisms are made up of one or more cells (Unicellular or Multicellular)**
   - Multicellular organisms' cells become differentiated and develop into specialized tissues; "Form fits Function"
   - **CELLS ➔ TISSUES ➔ ORGANS ➔ ORGAN SYSTEMS ➔ MULTICELLULAR ORGANISM**

2. **Organization** – Cells are organized,
   - different cells/organelles/tissues/organs have different functions but work together to make a fully functional system

3. **Matter, Energy and Organization** – All organisms made up of matter and need a constant energy source
   - **Autotroph** - makes own food energy (producers)
   - **Heterotroph** - consumes other organisms for food energy (consumers)
   - **Metabolism** - all energy using/producing reactions in the body

4. **Growth** – All organisms grow and need energy to grow
   - Grow because of cell division and cell enlargement; Use nutrients from food to build new cells
Unit 1: Introduction to Biology & Scientific Method

5. Reproduction – Produce organisms like themselves since the offspring inherits the parents' DNA
   - **Asexual** – offspring inherits DNA from one parent, identical to parent (unless mutation), occurs b/c of Binary Fission (prokaryotic) or Mitosis (eukaryotic)
   - **Sexual** – offspring inherits DNA from both parents, not identical to either parent

6. Evolution – Species' genes change over many generations;
   - DNA/genes change because of changes in enviro or mutations

7. Interdependence of Organisms – All species are dependent on each other, no species can survive without other species

8. Stability and Homeostasis
   - **Homeostasis** - stable, internal living conditions
   - Stable internal conditions not the same for all species
   - If homeostasis is altered, can interfere with functioning of cell/body
Unit 1: Introduction to Biology & Scientific Method

- **Steps of Scientific Method:**
  - **Observe a Problem**
  - **Hypothesis & Prediction**
    - Form a question you want to answer by conducting a scientific experiment.
    - Predict (make a guess) about what you think the outcome will be.
    - Many times the Hypothesis and Prediction are written in an *If, Then* statement.
  - **Experiment**
    - Many experiments compare a measurable change in two different groups.
      - The **Control Group** represents what would happen normally, no conditions are altered from the normal environment.
      - The **Experimental Group** has the experimental factor applied
        - *Experimental Factor* should cause a change in the independent variable
          - *Experimental Factor* – a.k.a. **Dependent Variable**
        - *Independent Variable* – measurable factor that is affected by the experimental factor
  - **Results** – look at and analyze results, Do the results support your prediction?
  - **Conclusion/Theory**
Questions 1 – 4

- Answer the questions on the next few slides on your answer sheet.
1. Frank flips the switch to turn on the light in his bedroom and nothing happens. He notices that the other lights in his home work and the radio in his room also works. Frank thinks the light bulb must be burned out. He gets a new bulb and replaces the old one. Once the bulb is replaced, Frank flips the light switch and the light turns on.

A. What is Frank's hypothesis/prediction?
Answer “Question A” by completing the following sentence:
If the light doesn’t work, then ____________

B. How does Frank test his hypothesis?

C. What is Frank's conclusion?
Observations:

1. Suprasweet is a new artificial sweetener. It is being added to some foods and drinks to reduce the amount of calories.

2. Scientists from a research institution report that another kind of artificial sweetener has been linked to bladder cancer in rats.

Hypothesis (Question scientists are testing):

- Does Suprasweet increase the risk of bladder cancer in humans?
Experiment:

- 100 rats are used in a controlled experiment with Suprasweet.
  - Fifty rats were given Suprasweet and were labeled as “Group A”.
  - The other fifty rats were given regular sugar and were labeled as “Group B”.
  - At the end of the experiment, all the rats were checked for bladder cancer.

Results of Experiment:

- Group A (Suprasweet Group): Nine of the fifty rats developed bladder cancer.
- Group B (Regular Sugar): One of the fifty rats developed bladder cancer.

*** CONTINUED ON NEXT SLIDE ***
Conclusion:

- Suprasweet appears to cause bladder cancer in rats. It may also cause cancer in man. Further studies will need to be conducted to determine if Suprasweet is an agent for causing cancer in man.

Questions to Answer on your answer sheet:

A. What is the concern about Suprasweet?
B. What is the Control Group?
C. What is the Experimental Group?
D. Do you agree with the conclusion? Why or why not?
A. Which hypothesis would most likely be tested using this setup?
   A. Green water plants release a gas in the presence of light.
   B. Roots of water plants absorb minerals in the absence of light.
   C. Green plants need light for cell division.
   D. Plants grow best in the absence of light.

* Explain your answer.
Question #4

4. The graph shows the results of a restocking program in which shrimp raised on a shrimp farm are released into the wild.

If this trend continues, about how many metric tons of shrimp will be released in 1999?

A. 12  
B. 13  
C. 14  
D. 15
Unit 2

- Cell Types (Chapter 4)
- Classification (Chapter 18)
- Read over the following summary of Unit 2.
- Answer the questions that follow (Questions 5 – 8).
Unit 2: Cell Types and Classification

**Cell Theory:**
- All living organisms are made up of one or more cells
- Cell is the basic unit of structure and function in a living organism
- Cells come only from the reproduction of existing cells

**Prokaryotic Cell**
- Domain Archae (Kingdom Archaebacteria) & Domain Bacteria (Kingdom Eubacteria)
- Cells with no nucleus or membrane bound organelles
- Smaller than eukaryotic cells
- Divide by Binary Fission (asexual reproduction)
- Prokaryotic Cells have:
  - Cell membrane, Cytoplasm, Cytosol, DNA (Free-floating), non-membrane organelles (ribosomes, cytoskeleton, etc).
  - Some have a cell wall. Some may have flagella or cilia.
Unit 2: Cell Types and Classification

- **Eukaryotic Cell**
  - Domain Eukarya (Kingdoms: Protista, Fungi, Plantae and Animalia)
  - Cells that have a nucleus and organelles
  - Divide by:
    - **Mitosis** – Cell divides once
      - Adds new body cells to multicellular organisms or
      - Used as asexual reproduction by unicellular organisms
    - **Meiosis** – cell divides twice, creates gametes (haploid cells)
  - Eukaryotic Cells have:
    - Cell membrane, Cytoplasm, Cytosol, DNA (in nucleus), nucleus, non-membrane organelles and membrane bound organelles.
    - Some have a cell wall. Some may have flagella or cilia.
Unit 2: Cell Types and Classification

- **Classification System** – We use a Three Domain System
  - Domain Archae (Kingdom Archaeabacteria)
  - Domain Bacteria (Kingdom Eubacteria)
  - Domain Eukarya (Kingdoms Protista, Fungi, Plantae, Animalia)

Domain → Kingdom → Phylum → Class → Order → Family → Genus → Species

- Living organisms are placed into a Domain, Kingdom, Phylum, etc based on a lot of information, including:
  - Cell Type (Prokaryotic or Eukaryotic)
  - Number of Cells (Unicellular or Multicellular)
  - Type of Nutrition (Autotroph, Heterotroph, Both)
  - Genetic Information (number of chromosomes, DNA sequence)
Domain → Kingdom → Phylum → Class → Order → Family → Genus → Species

**Binomial Nomenclature** – Scientific naming process

- All known species are classified into each of the categories listed above. The last two categories serve as the species’ scientific name. The name is italicized or underlined.
- The Genus name is capitalized, the species name is in lowercase.
- When comparing different species, you can determine how closely related the species’ are by looking at their classification.
  - The more categories they have in common, the closer related the species would be.
Unit 2: Cell Types and Classification

Domain → Kingdom → Phylum → Class → Order → Family → Genus → Species

- Which two species are the most closely related?
- Which species is the most unrelated to the other three?

- Humans (*Homo sapiens*):
  - Eukarya → Animalia → Chordata → Mammalia → Primate → Hominid → *Homo* → *sapiens*

- Peregrine Falcon (*Falco peregrinus*):
  - Eukarya → Animalia → Chordata → Aves → Falconiformes → Falconidae → *Falco* → *peregrinus*

- Dog (*Canis familiaris*):
  - Eukarya → Animalia → Chordata → Mammalia → Carnivora → Canidae → *Canis* → *familiaris*

- Flowering Dogwood Tree (*Cornus florida*)
  - Eukarya → Plantae → Spermatophyta → Magnoliopsida → Cornales → Cornaceae → *Cornus* → *florida*
• Answer questions 5 – 8 on your review sheet.
Unit 3

- Organelles (Chapter 4)
- Organ Systems (Chapter 4)
- Read over the following summary of Unit 3.
- Answer the questions that follow (Questions 9 – 10).
Unit 3: Organelles and Organs

- **Organelle** – Internal cellular structure with a specific job in the cell, *in all cells*
- **Cell Membrane** – outer boundary of cell, selectively permeable, phospholipid bilayer, *found in all cells*
- **Cell Wall** – outside cell membrane, adds support to some cells (fungi, plant, some protists, some bacteria)
- **Cytoplasm** – all material inside cell, includes cytosol (doesn’t include nucleus), *found in all cells*
- **Nucleus** – Stored DNA and Nucleolus
- **Nucleolus** – in nucleus, stores RNA, makes ribosomes
- **Ribosome** – makes protein, can be attached to ER (Bound Ribosome) or free floating in cytoplasm (Free Ribosome), *found in all cells*
  - Bound ribosome makes proteins for cell membrane or to leave the cell
  - Free ribosomes make proteins to be used inside the cell
- **Rough Endoplasmic Reticulum** – has ribosomes attached, checks proteins made by the ribosomes, if protein passes inspection, Rough ER packages the protein in a vesicle and sends the protein to the Golgi Apparatus
- **Golgi Apparatus** – Exports proteins from cell. Proteins sent here from the Rough ER. Golgi will store the proteins until the cell is ready to export. Golgi will package the proteins in a vesicle and send the proteins to the membrane. The proteins will be released outside the cell by the process of exocytosis.

- **Mitochondria** – Breaks down organic molecules (food) and created ATP (cellular energy), process called Cellular Respiration
  - Converts sugar into ATP

- **Lysosome** – Cleans out cell, filled with digestive enzymes and has an acidic pH (below 7 on pH scale), like the cells’ “stomach”

- **Cytoskeleton** – made up of protein fibers, gives cell its shape and size, supports organelles, helps organelles move around inside cell, *found in all cells*

- **Cilia and Flagella** – stick out of the cell, hair-like structures, help cell move and/or capture food, *found on some prokaryotic and some eukaryotic cells*

- **Vacuole** – stores water, waste, toxins
  - Plants have a very large and permanent vacuole

- **Plastid** – in plants, stores various materials
  - **Chloroplast** – type of plastid, stores chlorophyll, site of photosynthesis
<table>
<thead>
<tr>
<th>ORGANELLE</th>
<th>In bacteria?</th>
<th>In plant?</th>
<th>In animal?</th>
<th>STRUCTURE &amp; FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell membrane (Plasma membrane)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Boundary between intracellular &amp; extracellular environments. Regulates entry/exit of substances.</td>
</tr>
<tr>
<td>Cell wall</td>
<td>Yes, usually</td>
<td>Yes</td>
<td>No</td>
<td>Rigid structure providing support for cell.</td>
</tr>
<tr>
<td>Cytoplasm</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Jelly-like substance filling intracellular space contains dissolved substances.</td>
</tr>
<tr>
<td>Cyto-skeleton</td>
<td>Yes, usually</td>
<td>Yes</td>
<td>Yes</td>
<td>Network of fine tubes and threads. Provides internal structural support.</td>
</tr>
<tr>
<td>Nucleus</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Membrane-bound structure containing cells' genetic information (DNA) and support molecules.</td>
</tr>
<tr>
<td>Nucleolus</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Small structure within nucleus. Site of production of ribosomal RNA.</td>
</tr>
<tr>
<td>Nuclear Membrane</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Boundary between nucleus and cytoplasm. Regulates passage of materials between the two.</td>
</tr>
<tr>
<td>Flagella, pili or cilia</td>
<td>Sometimes</td>
<td>Only in some specialized cells.</td>
<td>Only in some specialized cells.</td>
<td>Structures used to enable movement of cells or sometimes to propel substances across outer surface of the cell. Predominantly protein in composition.</td>
</tr>
<tr>
<td>Mitochondria</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Membrane bound organelles. Folded membranes within contain enzymes for aerobic respiration. (A little DNA in here too.)</td>
</tr>
<tr>
<td>Chloroplasts</td>
<td>No</td>
<td>In photosynthetic cells</td>
<td>No</td>
<td>Membrane bound organelles. Folded membranes within contain chlorophyll and enzymes for photosynthesis. (A little DNA in here too.)</td>
</tr>
<tr>
<td>Vacuole</td>
<td>No</td>
<td>Yes, often large</td>
<td>Unusual, and small if present.</td>
<td>Membrane bound area filled with water and assorted solutes. Role in maintenance of water balance of the cell.</td>
</tr>
<tr>
<td>Ribosomes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Small organelles at which protein synthesis occurs. May be free floating or membrane-bound.</td>
</tr>
<tr>
<td>Smooth ER</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Network of flattened membranes forming tunnels. Enzymes assisting synthesis of some lipids and final processing of proteins found here.</td>
</tr>
<tr>
<td>Rough ER</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Similar to smooth ER, but with ribosomes embedded in membrane. Proteins to be exported from cell produced here.</td>
</tr>
<tr>
<td>Golgi apparatus (aka Golgi Body)</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Stacks of saucer shaped membranes where export proteins are modified and stored prior to entering secretory vesicles for exocytosis.</td>
</tr>
<tr>
<td>Lysosomes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Membrane bound structure-containing enzymes, which break down toxic or unwanted molecules.</td>
</tr>
<tr>
<td>Plastids</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Membrane bound structures with varied functions. Leucoplasts - starch storage. Chromoplasts - colored pigments within (e.g., flower petals).</td>
</tr>
</tbody>
</table>
## Animal/Plant Cell Comparison

<table>
<thead>
<tr>
<th>Similarities</th>
<th>Animal Cell</th>
<th>Plant Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cell membrane, Cytoplasm (&amp; organelles), Cytosol, Nucleus,</td>
<td></td>
</tr>
<tr>
<td>Differences</td>
<td>Small, temporary vacuole</td>
<td>Large, permanent vacuole</td>
</tr>
<tr>
<td></td>
<td>No cell wall</td>
<td>Have a cell wall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cell wall made up of cellulose (complex carb)</td>
</tr>
<tr>
<td></td>
<td>No chloroplasts/plastids</td>
<td>Have plastids and chloroplasts</td>
</tr>
</tbody>
</table>
• Answer questions 9 & 10 on your review sheet.
Unit 4: Chemistry & Nutrition

- Chemistry (Chapter 2)
- Organic Chemistry and Nutrition (Chapter 3 & 49)
- Read over the following summary of Unit 4.
- Answer the questions that follow (Questions 11 – 18).
Terms to know

- **Atom** – the smallest component of matter, consisting of a nucleus surrounded by orbitals of electrons.
- **Element** – specific type of atom.
- **Proton** – large mass, in the nucleus of atom, has a positive charge (P+).
- **Neutron** – large mass, in the nucleus of atom, has a neutral charge.
- **Electron** – very small mass, orbits nucleus of atom, has a negative charge (e-).
- **Isotope** – atoms with the same number of protons and electrons, but different numbers of neutrons.
- **Ion** – atom with a charge (+ or -), protons and electrons not in equal amount.
A review of the basic chemistry of small molecules

- On Earth, there are many different types of elements.
- The four most abundant elements in living organisms are:
  - Hydrogen (H)
  - Oxygen (O)
  - Nitrogen (N)
  - Carbon (C)
Polarity of Water

- A Water molecule is composed of one oxygen atom and two hydrogen atoms (H₂O).
  - Each hydrogen atom is covalently bonded to the oxygen.
- Water is a "polar" molecule because the electrons are not shared equally between oxygen and hydrogen.
  - Oxygen has a stronger pull on the electrons, so water has a partial negative charge near the oxygen atom and a partial positive charge near the hydrogen atoms.
- Hydrogen bonds occur between the negatively charged oxygen of one water molecule and the positively charged hydrogen of another water molecule.
Many other unique properties of water are due to hydrogen bonds.

For example, ice floats because hydrogen bonds hold water molecules further apart in a solid than in a liquid.

Water has strong surface tension, high specific heat, and is considered the universal solvent.

**Cohesion** – when water molecules form hydrogen bonds with other water molecules

**Adhesion** – when water molecules form hydrogen bonds with another surface.
The pH scale measures whether a solution is an acid or a base and uses a numerical range of 0 – 14.

- at pH 7.0, a solution is neutral
- at lower pH (0 – 6), a solution is acidic
  - *Examples*: Lemon juice, Vinegar, Stomach acid
- at higher pH (8 – 14), a solution is basic
  - *Examples*: Dish detergent, Baking soda, Tums, Alka-seltzer

- **Acids** have more hydronium ions (H\(^+\))
- **Bases** have more hydroxide ions (OH\(-\))
Carbohydrates

- Carbohydrates are a type of organic compound.
- Often referred to as “carbs”, “sugars” or “starches”.
- Made up of Carbon, Hydrogen and Oxygen
- **Functions**: Quick energy source for cells
  - **Monosaccharides** are also known as simple sugars.
    - Examples: glucose and fructose ($C_6H_{12}O_6$)
  - **Disaccharides** are also known as a double sugar and are composed of two monosaccharides joined together.
    - Examples: Sucrose (table sugar), Lactose (milk sugar)
  - **Polysaccharides** are long chains of monosaccharides bond together.
    - Examples:
      - Animals (including humans), store excess glucose in the form of **glycogen** in the liver and muscles.
      - Plants store glucose in the form of **starch**.
        - **Cellulose** is another polysaccharide makes up the cell wall of plants
        - Fungi cell walls are made up of a polysaccharide known as **chitin**.
Lipids

- Lipids are a type of organic compound. Often referred to as “fats”.
- Made up of Carbon, Hydrogen, and Oxygen (long carbon “tail”)

**Functions:**
- Provide long-term energy storage
- Important component of the cell membrane.
- Insulation and can be used to create a waterproof barrier

**Structure:**
- Structure of lipids make the molecule **Hydrophobic**, aka **Non-Polar**
  - Means not soluble in water
- Lipids can be saturated or unsaturated
  - **Saturated**—can lead to increased cholesterol levels in blood, solid at room temp
  - **Unsaturated** – less likely to lead to increased blood cholesterol levels, liquid at room temp.
Proteins

- Type of organic compound
- Made up of Carbon, Hydrogen, Oxygen and Nitrogen

**Function:**
- **Structural proteins** such as collagen or elastin, provide support
- **Enzymes** control cell processes
- Proteins are also a part of the immune system (antibodies), are used for oxygen transport (hemoglobin), and movement (muscles) etc.
- Most proteins work best at a specific temperature and pH range.

**Structure:**
- Proteins are a **polymer** (large molecule made up of subunits called monomers)
- The monomer of proteins are **amino acids**.
- There are 20 different amino acids that combine to form proteins.
ENZYMES (a type of protein)

- Enzymes allow living organisms to maintain homeostasis
- Enzymes function as **catalysts**
  - A catalyst lowers the amount of energy needed to start a chemical reaction
  - This allows chemical reactions to occur much faster
- Enzymes are not changed during the reaction and can be used many times
- Enzymes are specific for their substrate (reactant), much like a “lock and key”
- Enzyme names typically end in **–ase** (helicase, DNA polymerase, lactase)
• Answer questions 11 – 13 using information from the previous slides.

• Answer multiple choice questions 14 – 18 (questions following).
Lemurs’ bodies are adapted to efficiently store energy for time when food is scarce. This adaptation may help to explain how lemur ancestors survived the trip across the Mozambique Channel from mainland Africa to Madagascar.

14. Which of the following types of molecules would be most beneficial to the lemurs’ journey?

A. Carbohydrates
B. Lipids
C. Nucleic acids
D. Proteins

* Explain your answer
15. Which of the following best explains why enzymes are necessary for many cellular reactions?

A. Enzymes supply the oxygen necessary for the reactions.
B. Enzymes change reactants from solid to liquid during the reactions.
C. The reactions take up too much space in the cell if enzymes are missing.
D. The reactions are too slow to meet the needs of the cell if enzymes are missing.
16. Some insects can stand on the surface of the water because:

A. Water has a high specific heat

B. Water has a high boiling point

C. Water is a good evaporative coolant

D. Water molecules are cohesive and adhesive
17. Which statement summarizes the information in the graph?

A. These cells would survive best under acidic conditions
B. These cells would survive best under alkaline (base) conditions
C. These cells would survive better in distilled water
D. The survival of these cells does not affect pH
18. Certain poisons are toxic to organisms because they interfere with the function of enzymes in mitochondria. This would affect the cell’s ability to:

A. Build proteins
B. Store information
C. Dispose of metabolic wastes
D. Release energy from nutrients
Unit 5: Transport and Cell Membrane

- Cell Membrane (Chapter 4-1)
- Transport (Chapter 5)
- Read over the following summary of Unit 5.
- Answer the questions that follow (Questions 19 – 22).
Components of Cell (Plasma) Membrane

- **Phospholipids**
  - Make up the majority of the cell membrane
  - Double layered structure, known as a bilayer
  - **Hydrophilic** – Phosphate “heads”, face towards the outer part of the membrane
  - **Hydrophobic** – Lipid “tails”, point towards the middle of the membrane
  - This structure makes the membrane a selectively permeable barrier to hydrophilic and large-sized molecules. Only small, uncharged molecules can diffuse through the membrane.

- **Proteins** – two types of membrane proteins:
  - **Integral proteins** – go through the membrane
    - Include carrier proteins, ion channels, membrane pumps and glycoproteins
  - **Peripheral proteins** – attached to side of the membrane
  - Membrane proteins play roles in transporting materials through the membrane
Question #19

The diagram below shows a cross section of a cell membrane.

A. Describe the basic structure of the cell membrane.
B. Describe the primary functions of the cell membrane.
C. Explain how the membrane’s structure relates to its function.
Passive Transport

- **Passive Transport** – movement of molecules across a membrane without using ATP, molecules moving “down the gradient”. *Examples include:*
  - **Diffusion, Osmosis, Facilitated Diffusion, Ion Channel**
- **Diffusion** - the process by which molecules move from an area of high concentration to an area of low concentration.
- When the concentration of molecules are evenly spread out throughout a space - it is called **EQUILIBRIUM**
- **Concentration Gradient** – when there is a difference in the concentration between two different solutions
- **Osmosis** – the diffusion of water (across a membrane)
  - Water will move from an area of high concentration of water to an area of low concentration of water.
    - Water will move to where there is a lower concentration of water
    - Water will move to where there is a higher concentration of solutes
EFFECT OF OSMOSIS ON CELLS

Animal cells

• If the solution is **isotonic** relative to the cell, then the solute concentrations are the same on both sides of the membrane and water moves equally in both directions. Tap water and saline solutions are isotonic to a cell’s cytoplasm.

Plant cells

• A **hypertonic** solution has increased solute, and a net movement of water outside causing the cell to shrink. Corn syrup is a hypertonic solution to a cell (25% water, 75% solutes)
  • Cells are around 90% water, 10% solutes

• A **hypotonic** solution has decreased solute concentration, and a net movement of water inside the cell, causing swelling or breakage. Distilled water is a hypotonic solution to a cell (Distilled water is 100% water, 0% solutes)
ACTIVE TRANSPORT

- **Active Transport** – Movement of molecules across a membrane that requires ATP. Moves molecules “up the gradient” or “against the gradient”. Moves molecules from a low to high concentration.

- **Examples include:**
  - Membrane pumps, Endocytosis (pinocytosis and phagocytosis) and Exocytosis
  - Common membrane pump – **Sodium-Potassium pump**
BULK TRANSPORT

- **Endocytosis** - cell takes in large particles by engulfing (ingesting) them. Tiny pockets form along the membrane, fill with liquid, and pinch off.
- **Vesicle** – formed from membrane “pocket”, transports material through cell
- **Pinocytosis** – cell ingests liquid from the surrounding environment.
- **Phagocytosis** - "cell eating", cell ingests liquid and solid particles from surrounding environment.
- **Exocytosis** - cell gets rid of particles, opposite of endocytosis
- Answer questions 20 – 22.
- For each multiple choice question, explain why you chose that answer.
Question #20

20. An animal cell surrounded by fresh water (95% water) will burst because the osmotic pressure causes:

A. Water to move into the cell
B. Solutes to move into the cell
C. Water to move out of the cell
D. Solutes to move out of the cell
21. Placing wilted lettuce in cold water will make it crisp again. Which statement describes what happens to restore the lettuce to its original condition?

A. Water left the lettuce cells by diffusion
B. Osmosis caused salts to enter the lettuce cells
C. Salts in the leaf caused water to leave the cells
D. Water entered the cells of the lettuce by osmosis
Question #22

22. What would happen to an animal cell with an internal salt concentration of 0.8% if it were placed in a 20.0% salt solution?

A. Net movement of water out of the cell causes it to shrink
B. Net movement of water into the cell causes it to burst
C. There will not be any net movement of water
D. There will be a net movement of salt into the cell
Unit 6: DNA and Cell Division

- DNA Structure (Chapter 10-1)
- Cell Division (Chapter 8)
- Read over the following summary of Unit 6.
- Answer the questions that follow (Questions 23 – 32).
DNA (Deoxyribonucleic Acid)

- **Function**: Type of nucleic acid that stores our genetic information
  - **Gene** – codes for proteins
  - **Nucleic Acid** – organic compound made up of Carbon, Hydrogen, Oxygen and Phosphorous

- DNA is a **polymer** made up of **monomers** known as **nucleotides**.

- **Structure of DNA**: 
  - 2 parallel strands of nucleotides.
  - DNA Nucleotides are made up of three parts: a deoxyribose sugar, a phosphate group, a nitrogen base
    - Nitrogen Bases: Adenine, Guanine, Thymine, Cytosine
    - Adenine pairs with Thymine, Guanine pairs with Cytosine
The Cell Cycle
Phases of the Cell Cycle:

- Interphase
- Prophase
- Metaphase
- Anaphase
- Telophase
- Cytokinesis

The cell then goes back into Interphase.
**Interphase** – The Cell spends the majority of its life here, growing and functioning. Interphase is made up of three stages:

- **G1**: Cell grows and does normal cell activity
- **S Phase**: Synthesis Phase (DNA Replication)
- **G2**: Cell grows, copies organelles, and gets ready to divide
Prophase of Mitosis:
- DNA coils around histone proteins to form a chromosome.
- Sister chromatids held together by the centromere (looks like “X”)
- Nucleus breaks down
- Centrosomes are formed and move to opposite ends of the cell. Centrosomes form spindle fibers.
During **Metaphase**:  
- Chromosomes line up across center of the cell, also called the equator, or Metaphase plate.  
- Spindle fibers attach to the centromere of the chromosome.
In **Anaphase** the:
- Spindle fibers shorten and pull apart the centromere. This separates the sister chromatids.
- Chromatids are pulled to opposite ends of cell
In **Telophase** the:
- Nuclear membrane reforms around each group of chromatids (chromosomes)
- Centrosomes and spindle fibers break down
- Cell gets ready for cytoplasm to divide
Cytokinesis takes place when the Cytoplasm divides and two cells with identical genetic material are formed.  
- In humans: Makes new body cells (Somatic Cells), produces two diploid cells  
- In plants: Cell plate forms between the two cells

Daughter Cells
Meiosis

- Produces new reproductive cells (*gametes*)
  - Male = Sperm
  - Female = Eggs

- Only occurs in cells of reproductive organs
- All other body cells undergo mitosis

- In meiosis, the cell divides twice, resulting in 4 haploid cells.
  - First cell division: Meiosis I
  - Second cell division: Meiosis II
During meiosis, chromosome number in each cell is reduced.

Parent cell contains homologous pair of chromosomes

MEIOSIS I

Homologs separate

Sister chromatids separate

MEIOSIS II

Daughter cells contain just one homolog

Four daughter cells contain one chromosome each. These cells become gametes.
• Answer questions 23 – 32.
• For each multiple choice question, explain why you chose that answer.
Question #23

23. A double helix strand of DNA is made up of a total 100 nucleotides. If 30% of the nucleotides are Thymine, what is the percentage of Cytosine, Adenine and Guanine?
Question #24

24. The presence of DNA is important for cellular metabolic activities because DNA:

A. Directs the production of enzymes and other proteins
B. Is a structural component of cell walls
C. Directly increases the solubility of nutrients
D. Is the major component of cytoplasm
Question #25

25. Tissue (cell) samples taken from the heart and stomach of a grasshopper would probably have the same:

A. Cell shape
B. Cell size
C. DNA
D. Metabolic rate
26. Which series of bases will complete this strand of DNA?

A. CCT GAT
B. ACT GGC
C. GTA GGC
D. TCA GGG
27. The process of cloning involves making an identical copy of a cell's:

A. Cytoplasm
B. DNA
C. Ribosomes
D. ATP
28. If the 46 strands of DNA in one human cell were stretched out, they would measure over 6 feet long! One of the factors allowing DNA to fit inside the nucleus of a cell is its ability to:

A. Break apart into separate genes  
B. Extend to form very long, thin molecules  
C. Denature (break down) from the effect of an enzyme  
D. Coil tightly around histone proteins
29. Which of the following phases takes up most of the cell cycle?

A. Interphase  
B. Prophase  
C. Mitosis  
D. Anaphase  
E. Telophase
Question #30

30. Mitosis is most important for a kitten’s:

A. Vision
B. Respiration
C. Growth
D. Metabolism
E. Cuteness
31. Which term *best describes* the type of cell division in which parent cells produce daughter cells with the same number of chromosomes as the parent cells?

A. Mitosis  
B. Meiosis  
C. Spermatogenesis  
D. Oogenesis
32. The body cells of an individual plant have 50 chromosomes. How many chromosomes would be found in the gametes produced this plant?

A. 5
B. 10
C. 25
D. 50